

**A LEVEL**

**Examiners' report**

# **DESIGN AND TECHNOLOGY: PRODUCT DESIGN**

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**H406**

For first teaching in 2017

**H406/01 Summer 2024 series**

# Contents

Introduction .....	3
Paper 1 series overview .....	4
Question 1 (a) .....	5
Question 1 (b) .....	6
Question 1 (c) .....	6
Question 1 (d) (i) .....	7
Question 1 (d) (ii) .....	8
Question 1 (e) .....	9
Question 2 (a) .....	10
Question 2 (b) (i) .....	11
Questions 2 (b) (ii) and 2 (b) (iii) .....	12
Question 2 (c) (i) .....	13
Question 2 (c) (ii) .....	15
Questions 3 (a) and 3 (b) .....	16
Question 3 (c)* .....	17
Question 4 (a) (i) .....	19
Question 4 (a) (ii) .....	21
Question 4 (a) (iii) .....	24
Questions 4 (b) (i) and 4 (b) (ii) .....	24
Question 4 (b) (iii) .....	25
Question 4 (b) (iv) .....	25
Copyright information .....	26

## Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

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## Paper 1 series overview

This component is the first of two examined components and makes up approximately a quarter of the total A Level qualification. This paper is set out through four sets of questions that predominantly cover technical principles within Product Design and require candidates to: analyse existing products, demonstrate mathematical skills in a D&T context, demonstrate their technical knowledge of materials, product functionality, manufacturing processes and techniques; and to demonstrate their understanding of wider social, moral, and environmental issues that impact on the design and manufacturing industries.

To do well in this component candidates need to analyse modern consumer products that are designed to meet consumer needs, their design and manufacture, and show understanding of product development and commercial practices. Candidates are tested on a range of materials and components used in the manufacture of products, as outlined in the specification.

Candidates need to show clear understanding of topics through extended written responses and support discussions with evaluation and use of examples. In mathematical skills questions candidates need to show workings, if an answer is incorrect but the method used is correct, candidates can gain access to some marks.

Many of the questions within the paper are based on consumer products made from multiple materials or multiple parts, candidates are expected to analyse the product and refer to it in context to support their answers.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> <li>related their responses to the products or context of the product</li> <li>showed clear workings in Maths questions</li> <li>used examples and evaluation to support extended responses</li> <li>included quality control checks and detail of tooling in the manufacture/process question and covered the process fully.</li> </ul>	<ul style="list-style-type: none"> <li>gave generic answers that did not relate to the product or its context</li> <li>focused on one or two aspects in extended responses rather than appreciating the complexity of the topic</li> <li>gave little support with examples in extended responses</li> <li>gave little detail of specific tools, machinery, or quality control in the process question</li> <li>responded to the manufacture questions with a process that was inappropriate or inefficient for the product, material or level of production required.</li> </ul>

## Question 1 (a)

- 1 A hearing aid is a device that fits on a person's ear to make sounds clearer and louder.

There are different types of hearing aid and some can be programmed and controlled remotely.

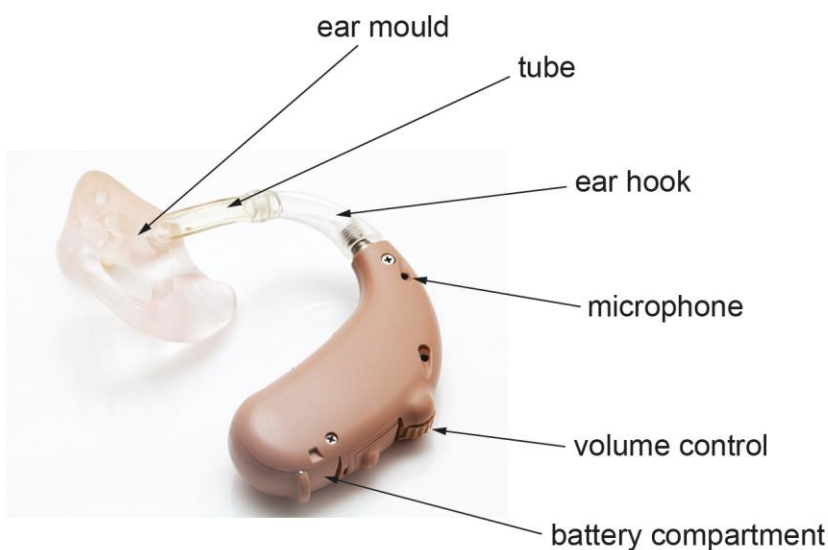
**Fig. 1.1** shows a basic hearing aid in use.

**Fig. 1.2** shows a labelled photograph of a hearing aid.

**Fig. 1.1**



**Fig. 1.2**



- (a) Identify a suitable specific material for the ear mould.

Justify your answer.

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..... [2]

Most candidates answered this question well by suggesting suitable mouldable and transparent material, justifying how they suited the intended use of the ear mould by being flexible and comfortable for the user or had the ability to be moulded to shape. There was a wide range of materials suggested mainly, silicone rubber, thermopolymers or smart materials.

## Question 1 (b)

(b) Explain why extrusion would be used to manufacture the tube.

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..... [2]

Many candidates were able to understand that this process is made to make a continuous cross-section or a uniform structure that can be cut to lengths, however some misread the question describing the shape of the tube rather than referring to the process of extrusion and why it is suitable.

## Question 1 (c)

(c) Explain how **two** features of the hearing aid improve ease of use.

1 .....

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2 .....

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..... [4]

Many candidates answered this well as they were successfully able to highlight design features of the hearing aid and how these would aid the user with the daily function/ use of the product. An explanation of both the design feature and how it improves ease of use/usability is required for two marks.

## Question 1 (d) (i)

- (d) Hearing aids are becoming increasingly more sophisticated.
- (i) Discuss the influences new and emerging technologies could have on the design of the hearing aid.

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..... [6]

This question was well answered with many candidates showing a good understanding of new and emerging technologies and how they could develop the size, shape, materials and functionality of the design, to improve its functionality, manufacturing and/or ergonomics. Technologies included 3D printing to customise manufacturing, Artificial Intelligence (AI) to monitor sound levels and adapt accordingly, the Internet of Things (IoT) and Bluetooth technology enabling users to link the hearing aid to their phone and other devices, implants and the use of hydrophobic coatings, smart materials and graphene.

## Exemplar 1

As more technologies are emerging, such as wireless charging could be used in the design of the battery of the hearing aid, users can leave the product on charge when they go to sleep instead of having to change the whole battery after few weeks.

The designer may want to add blue-tooth connection with the user's phone, so that users can check the conditions, batteries, product life easily on using digital technology, and get problems fixed before it breaks down.

The designers might want to improve it to have functions such as voice recording, this allows users to check backup if they didn't heard it.

~~users may~~ designers could add a GPS technology onto the design of the hearing aid, ~~to~~ in case users can't find them as it is normally expensive.

users may track the product on their phone.

Exemplar 1 is a Level 3 response that outlines several new and emerging technologies and how they could improve the design and its functionality, such as wireless charging, Bluetooth, IoT and GPS.

## Question 1 (d) (ii)

- (ii) Identify **three** impacts on the user of incorporating new and emerging technologies into the design of the hearing aid.

Justify **each** of your answers.

1 .....

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2 .....

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3 .....

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[6]

The question required candidates to consider the impact that incorporating new and emerging technologies would have on the user of the hearing aid, many candidates were able to identify specific technologies and how they could impact the size, shape, materials, cost, functionality and usability of the hearing aid. Many candidates focused on positive impacts the more successful candidates identified both positive and negative impacts relating to different user groups, e.g. children or the elderly.



## Question 1 (e)

- (e) Explain how the hearing aid components could have been designed for disposal and end of product life.

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..... [3]

Many candidates suggested aspects of the device that could be taken apart or disassembled easily and related to the positive effects of recycling or reuse of components and/or materials to create a circular approach, with some suggesting how consumers could be encouraged to dispose of carefully at the end of life.

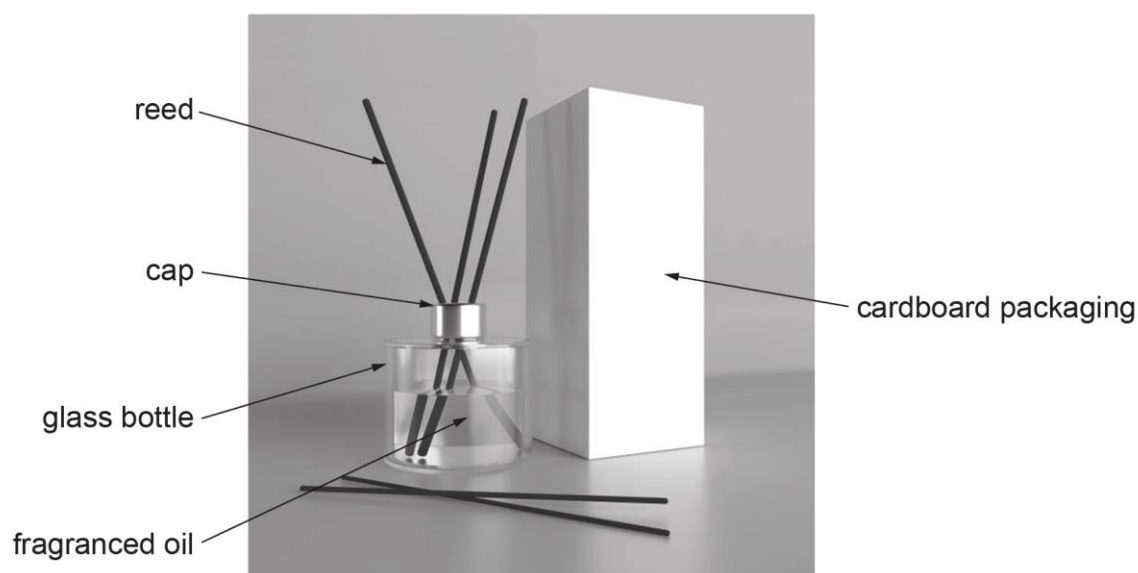
## Question 2 (a)

- 2 A reed diffuser is a product used in the home that allows a fragrance to fill a room.

Reeds are placed in a bottle containing fragranced oil. The fragrance is drawn to the top of the reed where it is released into the air.

Fig. 2.1 shows the product and cardboard packaging.

Fig. 2.1



- (a) Identify and explain **two** reasons why sales of the reed diffuser may have increased in recent years.

1 .....

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2 .....

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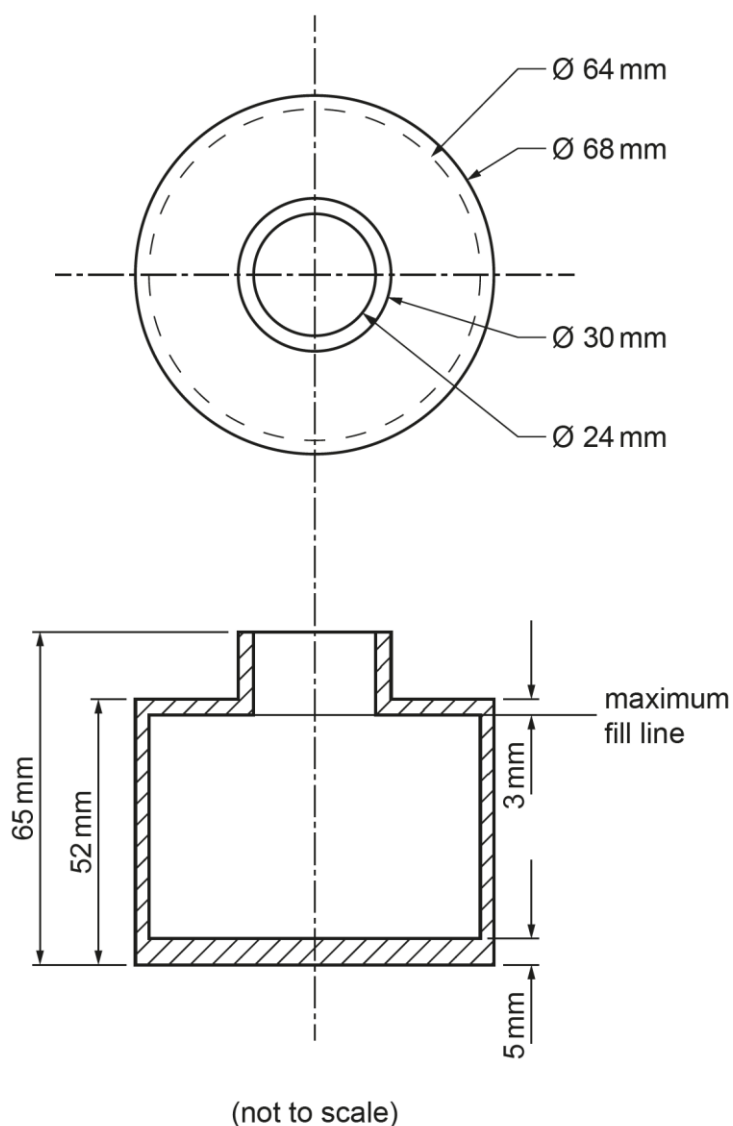
[4]

This question was well answered with sound and well-supported reasons. Candidates often cited the COVID 19 pandemic and the rise of remote work or pollution and even pet smells. Some candidates touched on the social media influencers and the health and wellbeing effects of reed diffusers or the positive impact on the environment compared to candles or aerosol air fresheners.

## Question 2 (b) (i)

Fig. 2.2 shows a diagram of the cylindrical glass bottle.

Fig. 2.2



(b)

- (i) Use the information from Fig. 2.2 to calculate the volume of the bottle up to the maximum fill line. Give your answer to the nearest  $\text{cm}^3$  and show your working. [4]

Volume of bottle .....  $\text{cm}^3$

Most candidates identified and used the correct volume formula, some candidates presented answers in the wrong units or miscalculated the height. It is important to show workings as marks can be given for working out even if a final answer is incorrect. A significant number of candidates worked out the area instead of volume.

## Questions 2 (b) (ii) and 2 (b) (iii)

(ii) The oil costs £10 per litre.

For quantities over one litre the supplier will apply a 3% discount **to the total cost**.

Complete the table below to show the cost of the oil at different quantities.

[2]

Quantity of Oil	Cost
1 litre	£10.00
2 litres	
3 litres	
4 litres	
5 litres	

(iii) The oil is sold in 25 ml increments.

Use your answer from **part (b)(i)** to calculate how many increments of oil are needed to fill each bottle to the maximum fill line. Show your working.

[2]

$$1 \text{ ml} = 1 \text{ cm}^3$$

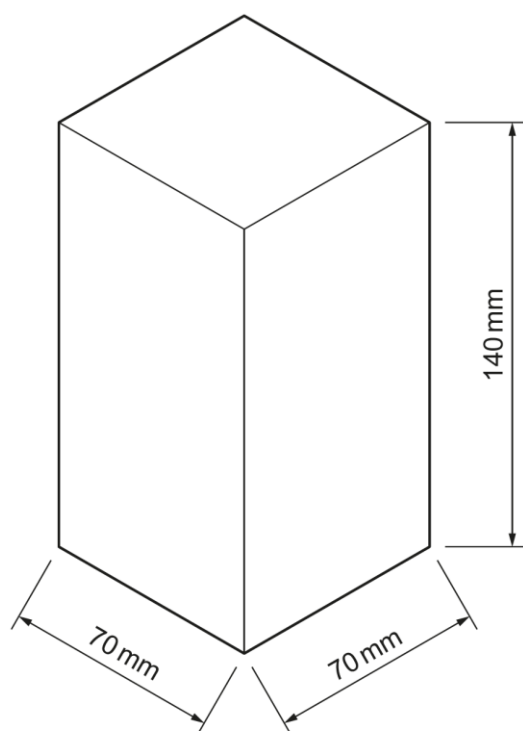
Number of increments .....

These two questions tested maths in context and were both answered well. 2biii allowed candidates to use their answer from part bi. Some candidates rounded their number down rather than up but where workings were shown credit for process could be given.

## Question 2 (c) (i)

Fig. 2.3 shows the cuboid cardboard packaging for the reed diffuser.

Fig. 2.3

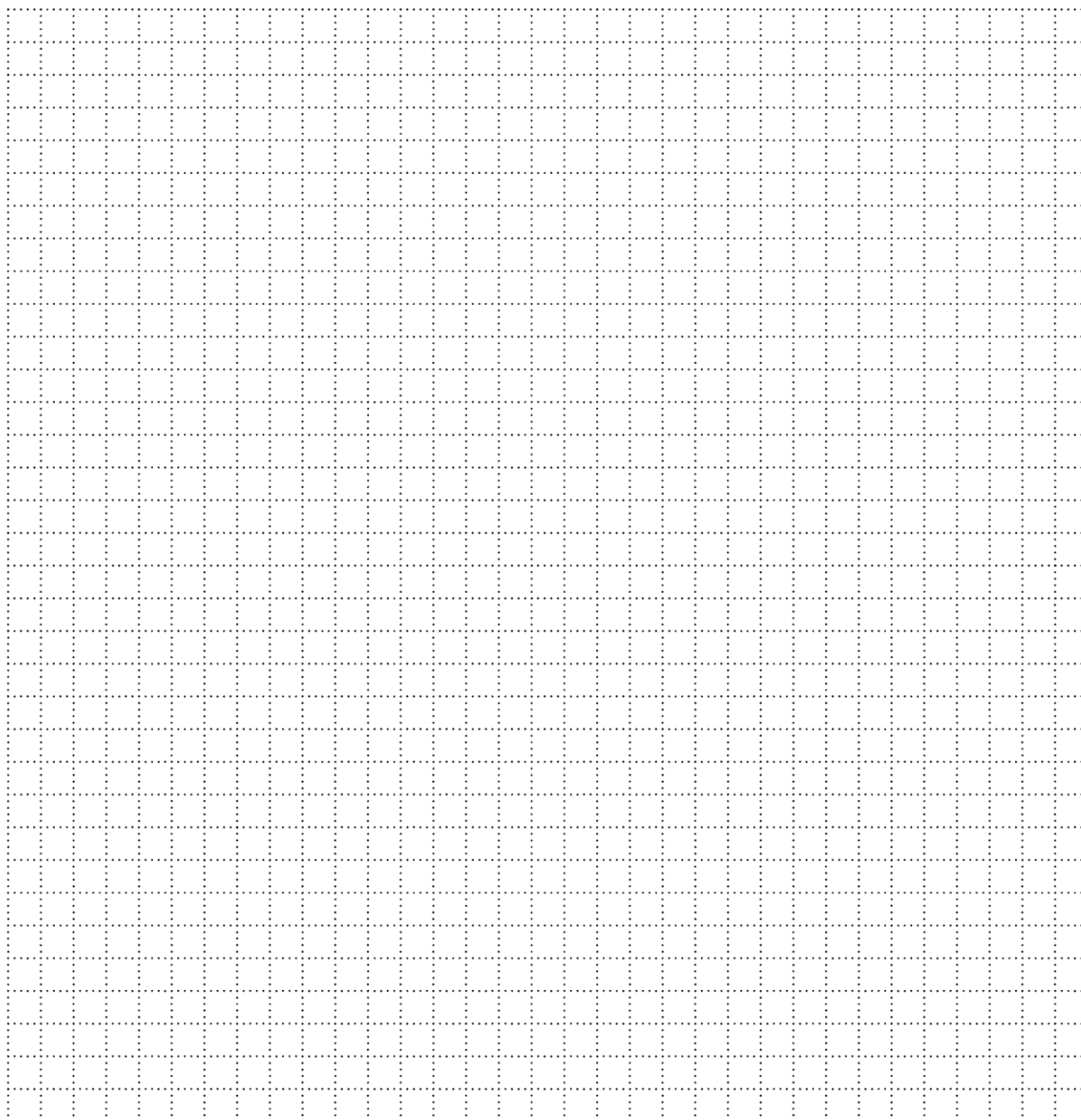


(not to scale)

- (c) The cuboid cardboard packaging has four sides, a top and a bottom.
- (i) Use the information from **Fig. 2.3** to draw a surface development (net) for the cuboid cardboard packaging.

Include glue tabs in your design.

[5]



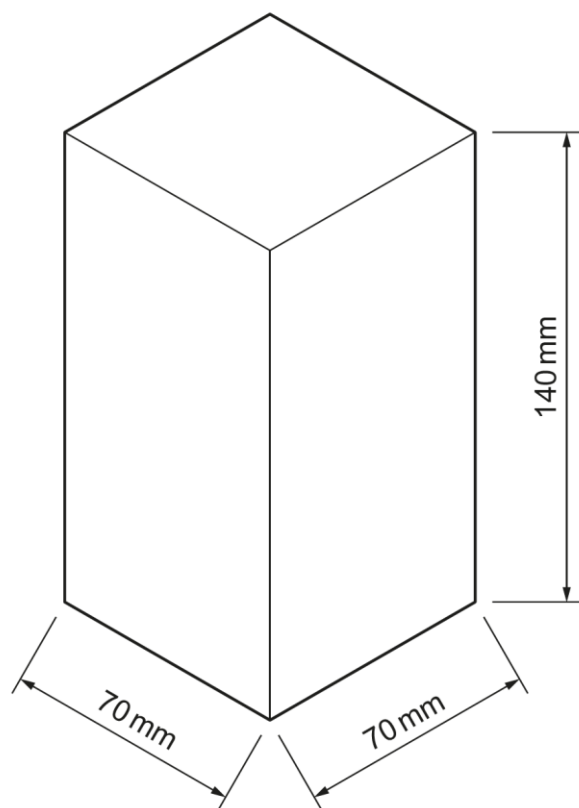
1 SQUARE represents 10 MM

The majority of candidates were able to correctly draw a net with six panels to the correct dimensions with sufficient glue tabs for a workable solution. For drawing questions: the need to be accurate is significant and candidates should be reminded to have sharp pencils and draw with precision to achieve full marks.

**Question 2 (c) (ii)**

This is a repeat drawing of **Fig. 2.3**.

**Fig. 2.3**



(not to scale)

- (ii) Calculate the external surface area of the cuboid cardboard packaging excluding any glue tabs.  
Give your answer in  $\text{cm}^2$  and show your working. **[2]**

External surface area .....  $\text{cm}^2$

This maths question was answered well. Some candidates presented their answer in the wrong units or included the area of their glue tabs but where workings were shown credit for process could be given.

### Questions 3 (a) and 3 (b)

**3** Developments in design thinking and industrial manufacture have been influenced by a wide range of factors.

**(a)** Describe what is meant by the term Ethical Trade Initiative (ETI).

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..... [2]

**(b)** Describe what is meant by the term Fair Trade (FT).

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..... [2]

These two terms are on the specification and answers required descriptions, for the Ethical Trade Initiative (ETI) a number of candidates provided narrow responses about business ethics rather than making reference to an alliance of companies and trade unions and their support for human rights risks in supply chains around the world. The Fair Trade (FT) definition was answered well by many candidates referring to both working conditions and payment/wages for farmers, responses were often supported by examples.



### Question 3 (c)\*

**(c)\*** Discuss the challenges and issues faced by designers and manufacturers when supporting the Ethical Trade Initiative and Fair Trade.

Use specific examples of challenges and issues in your answer.

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..... **[8]**

This question was answered well by candidates covering the challenges faced by both manufacturers and designers. Stronger responses covered a range of challenges such as how ethical sourcing of materials and improved working conditions may lead to increased costs and how this then could drive the price of the product up; and how a more limited choices of suppliers might lead to delays in production. Responses also covered that promotion of ethical choices could lead to the increased desirability from consumers who are looking for ethical brands but how this can also present challenges.

## Exemplar 2

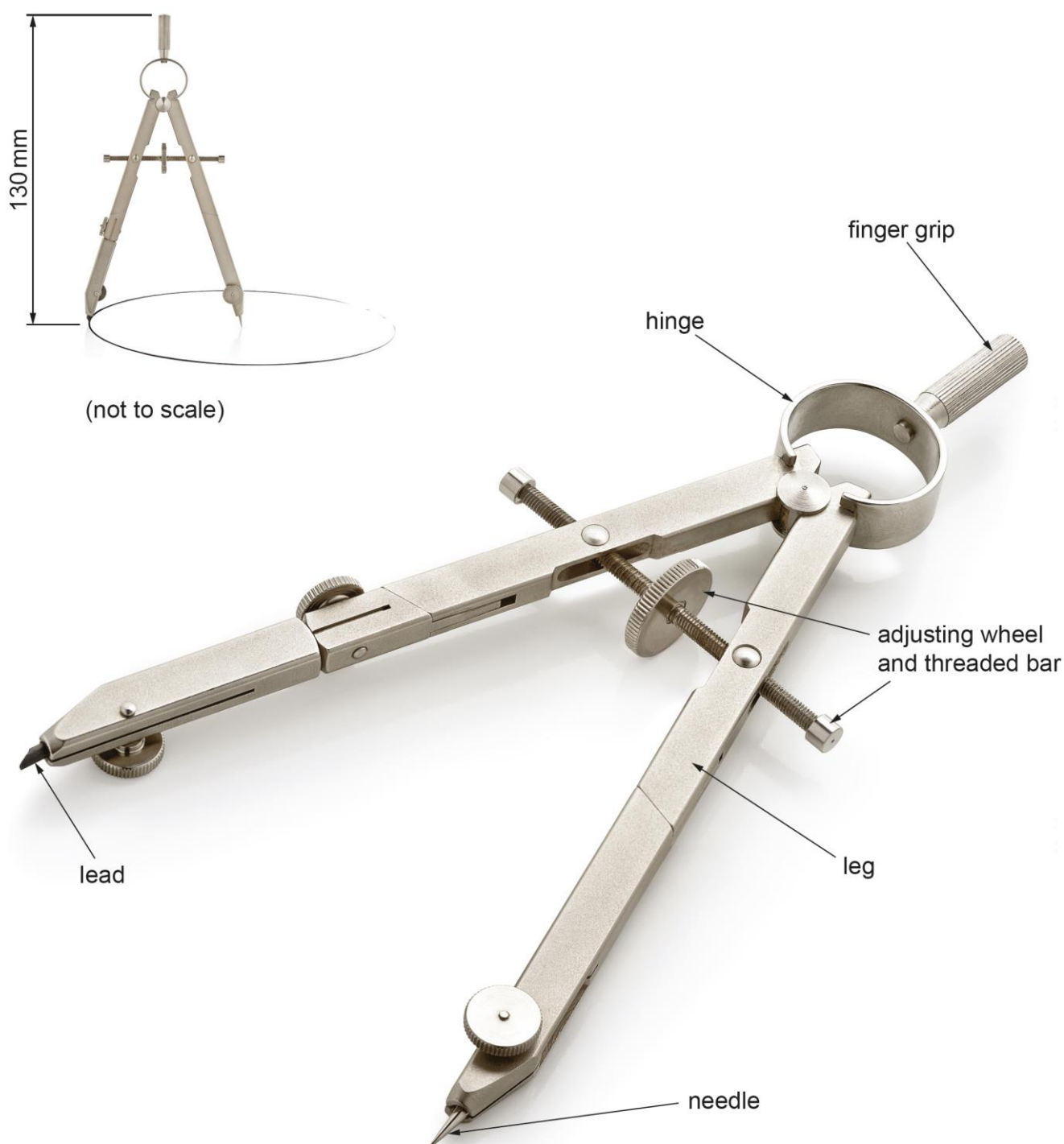
The use of regulations and legislation such as ETI and FT ensure designers take into account ethical, social and environmental implications of their designs. A challenge faced by designers and manufacturers could be increased costs. Fair trade items, such as bananas, could cost more than non-fairtrade alternatives as everyone involved in the process is paid at least minimum wage. Designers may seek to manufacture products in underdeveloped countries where the minimum wage is lower, in order to lower overall costs of the product, for example, how Nike has investments in Vietnam. Another issue faced by manufacturers when supporting ETI and FT is they must ensure safe working conditions for their workers, ~~which~~ which involves complying with <sup>legislation such as</sup> the Worker Protection Act, and the Health and Safety at ~~Work~~ Act, where workers need up to date training for machinery, clear signage and use of zones in factories, enforced health regulation for chemicals, appropriate PPE and first aid kits. This may be an issue for manufacturers as enforcing all these criteria may be time consuming and add extra costs. Therefore, these legislation and certification don't allow companies to cut corners with their supply chain, meaning small businesses and suppliers are not marginalised, however this results in higher costs and more responsibilities ~~for~~ for the designer and manufacturer.

Exemplar 2 is a Level 3 response achieving full marks that covers a number of challenges and uses examples of companies and workplace legislation to support their answer. The use of examples to support discussion questions is required for the highest marks.

### Question 4 (a) (i)

4 Fig. 4.1 shows a drawing compass used for drawing circles.

Fig. 4.1



- (a) A company is looking into whether the component parts of the compass could be manufactured in large quantities.
- (i) Use annotated sketches and/or notes to show how a **single prototype** of the **adjusting wheel and threaded bar** could be manufactured in a workshop environment.

Identify any relevant tools, machinery and materials.

[5]

This question allowed candidates to demonstrate their understanding of the process used to make a single prototype in a workshop, it was answered well by candidates providing a series of annotated sketches and/or notes. A number of suitable methods were seen from the use of a centre lathe to pewter casting the wheel and use of taps and dies to cut internal and external threads or the use of 3D printing. A small number of candidates suggested processes that were unsuitable for making a one-off prototype of the threaded bar and wheel.

## Question 4 (a) (ii)

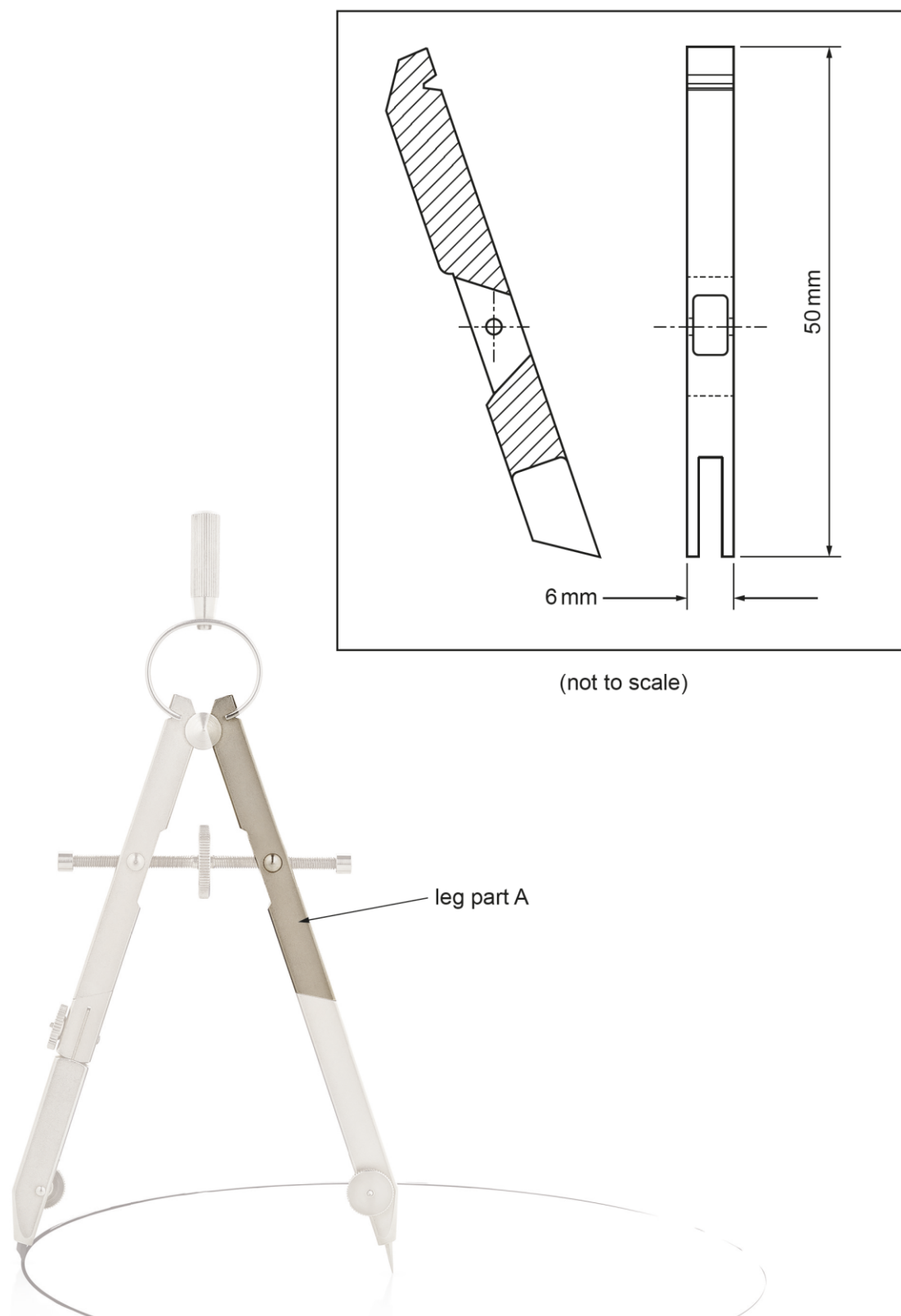
- (ii) Use annotated sketches and/or notes to show how the **leg part A** could be manufactured as a batch of 100 000 from metal.

Identify any relevant specialist tooling and quality control checks.

[8]

Fig. 4.2 shows a drawing of the leg part A of the drawing compass highlighted below.

Fig. 4.2



The most efficient or most suitable for a batch of 100,000 of the compass leg (part A) from metal that is cost effective would be die casting; a significant number of candidates identified this and provided a good level of detail of the process. For a batch of 100,000 and a product that is small and detailed, sand casting is not an appropriate method.

### Assessment for learning



Candidates should be encouraged to extend responses beyond a textbook response and relate to the specific product and include technical terms and details any relevant specialist tooling and quality control checks to score highly in manufacturing process questions. Quality control checks take place during and after manufacture.



## Exemplar 3

Firstly you would get your ~~sheet metal~~ ~~of aluminium~~ pellets of metal and ~~inspect them~~ ~~QC~~ check they are all the same size and no chunks.

① ~~put your mould in~~ create your mould of the aluminium leg part

② ~~You would then~~ ~~put~~ a robotic arm would take the pellets and automatically put them into a beaker that is in ~~water~~ that is heated at  $300^{\circ}\text{C}$  - (QC) check it is the correct temperature by using a thermometer

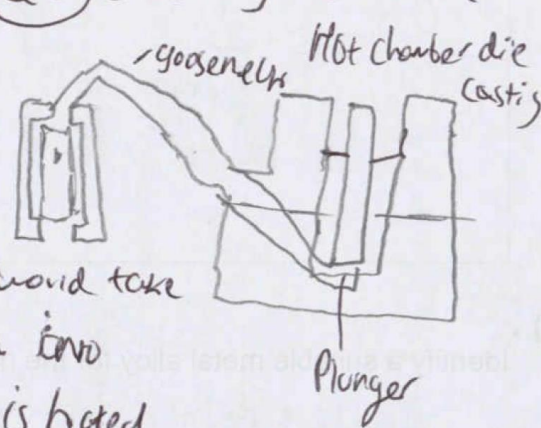
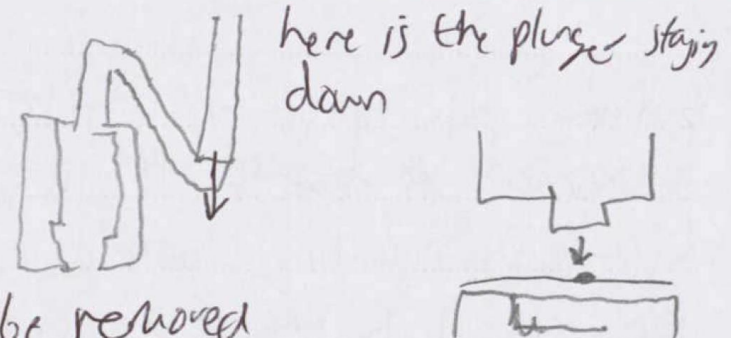
③ the plunger will then pull down and the heated plastic will go into the gooseneck and end up in the mould. the plunger will stay down until the cavity in the mould is completely filled

④ After it will be allowed to cool for ~~2-3 mins~~ and then will be removed

⑤ The plunger will go back up ready for the next pellets from the automatic robotic arm to put in

⑥ A hole will need to be drilled in position using a piercing process where a hydraulic press will come down and create the hole. A jig will be in place to ensure accuracy.

⑦ Finally the pop rivet will be put in to be able to attach themselves to a bar

Exemplar 3 is a Level 3 response and uses both diagrams and notes to explain the die casting process with quality control throughout the process.

### Question 4 (a) (iii)

(iii) The manufacturer carried out quality checks on each compass.

It noted that 20 in each batch of 100 000 are faulty.

Calculate the probability of a faulty compass. Give your answer as a % and show your working.

[2]

Probability ..... %

Most candidates responded correctly to this maths question giving the answer as a percentage. where the final answer was not as a percentage, but candidates showed their working credit was awarded.

### Questions 4 (b) (i) and 4 (b) (ii)

(b)

(i) Identify a suitable metal alloy for the needle of the drawing compass.

..... [1]

(ii) Identify **two** properties of the metal alloy you have identified in **part (b)(i)** that make it suitable for the needle of the drawing compass.

Justify **each** of your answers.

1 .....

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2 .....

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[4]

This question was answered correctly by most candidates and suitable metals that are commonly alloyed were credited. Many were then able to explain the specific properties of the material they chose and how this specific property related to the use of the compass. Properties suitable for the compass included corrosion resistant, good compressive strength, durability, hardness and toughness.



### Question 4 (b) (iii)

(iii) Describe how **one** of the raw materials for the metal alloy would be extracted from its origin.

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..... [2]

This question required candidates to describe how one of the raw materials in the metal alloy is extracted from the ground and refined. Common answers were for iron ore being mined from the ground and refined by smelting in a blast furnace to remove impurities or, bauxite ore mined and then refined using electrolysis to separate impurities to extract aluminium. Most candidates were able to describe the process however not all provided enough depth for 2 marks.

### Question 4 (b) (iv)

(iv) Describe **two** ways in which lean manufacturing could have impacted the production of the drawing compass.

1 .....

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2 .....

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..... [4]

A number of candidates described the benefits of Just in Time manufacture rather than considering how Lean Manufacture could impact the production of the compass. However, there were some strong responses covering aspects such as the elimination of waste from recycling the flashing or sprues by feeding it back into the die casting process. Reduction of components within the compass design to have less stages in the production and how this would save time and costs and more efficient workstations/factory layout organised with consecutive tasks next to one another to avoid time lost and speed up manufacture.

## Copyright information

Question 1: Photo of young boy using a hearing aid. istockphoto-1209329156, © aerogondo / Getty Images

Question 1: Photo of a Digital Hearing Aid. istockphoto-182056715, © Gannet77 / Getty Images

Question 2: Photo of a 3D render aroma diffuser mock-up with sticks and packaging with space for box and sticker design. Stock photo ID:1364253768, © Oksana Vetrova / Getty Images

Question 4: Photo of a Drawing Compass. Stock photo ID:839564786, © chictype / Getty Images

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